Software Assurance Curriculum Project

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Agenda

SwA Curriculum Project

- Project background
- Overview of curriculum project
- How universities can adopt MSwA material
- Next steps

Project Background

Sponsorship and Goals

Sponsored by the Department of Homeland Security (DHS) National Cyber Security Division (NCSD)

Activity led by the Software Engineering Institute (SEI) at Carnegie Mellon University

Goals

- develop a curriculum for a Master in Software Assurance degree program
- define transition strategies for future implementation

Curriculum Context

Discipline of software assurance (SwA) targeted specifically to the security and correct functioning of software systems, whatever their

- origins
- subject matter
- operational environments

Need for a master's level program in the discipline of software assurance has been growing for years

Audiences for Curriculum

The following groups may find the curriculum valuable:

- faculty responsible for designing, developing, and maintaining graduate software engineering programs that focus on software assurance knowledge and practices
- those in development & acquisition organizations responsible for either of the following:
  - staffing positions in software assurance
  - providing current software engineers with increased software assurance capabilities
- those who assess software assurance oriented programs

Curriculum Development Team (2009-10)

Members represent multiple organizations:

- Nancy Mead (Lead) - SEI
- Julia Allen - SEI
- Mark Ardis - Stevens Institute of Technology
- Tom Hilburn - Embry-Riddle Aeronautical University (ERAU)
- Andrew Kornecki - ERAU
- Rick Linger - SEI
- Jim McDonald - Monmouth University
- Jennifer Kent (Editor) - SEI
- Tracey Tamules (Admin) - SEI

Purpose of MSwA Curriculum Project

Develop and present a core body of knowledge that can be drawn from to create

- standalone software assurance degree program
- track within existing master's degree programs
  - Software Engineering; Information Systems

Foundational material includes (but not limited to)

- WE & T materials, including Software Assurance Curriculum Body of Knowledge (SwACBK) [DHS 2010b]
- work done by the SEI in support of DHS Build Security In (BSI) website [DHS 2010a]
- Graduate Software Engineering 2009 *(GSwE 2009)* Curriculum Guidelines for Graduate Degree Programs in Software Engineering [iSSEc 2009]

SwA Workforce Education & Training

Sponsored by DHS NCSD

Software Assurance Working Group on Workforce Education and Training (SwA WE&T WG)

Primarily focused on education, with related work in training and certification

Workforce Education & Training Products

- Software Assurance Curriculum Guide to the Common Body of Knowledge
- Software System Security Principles and Guidelines
- Secure Software Engineering Education (example courses)
- Pocket Guide “Software Assurance In Education, Training & Certification”

Overview of Master of Software Assurance Curriculum Project

MSwA Project Primary Objectives

Improve the state of software assurance education

Develop a Master of Software Assurance Reference Curriculum (Volume I)

Identify educational offerings at other levels

- Undergraduate (Volume II)
- Community colleges (Future)

Body of Knowledge (BoK)

Organization: BoK knowledge areas → knowledge units → knowledge topics, with associated Bloom cognitive levels

- Assurance Process and Management
  - Assurance Across Life Cycles
  - Risk Management
  - Assurance Assessment
  - Assurance Management
- Assurance Product and Technology
  - System Security Assurance
  - Assured Software Analytics
  - System Operational Assurance

Architectural Structure of an MSwA2010 Degree Program

Preparatory Materials	Computing Foundations Software Engineering Security Engineering
MSwA Core	Assurance Across Life Cycles Risk Management Assurance Assessment Assurance Management System Security Assurance Assured Software Analytics System Operational Assurance
Electives	Courses Related to Assurance in Selected Domains
Capstone Experience	Project

MSwE with SwA Specialization

Preparatory Materials	Computing Foundations Software Engineering Security Engineering
GSwE Core	Ethics and Professional Conduct Systems Engineering Requirements Engineering Software Design Software Construction Software Testing Software Maintenance Configuration Management Software Engineering Management Software Engineering Processes Software Quality
MSwA Core	Assurance Across Life Cycles Risk Management Assurance Assessment Assurance Management System Security Assurance Assured Software Analytics System Operational Assurance
Capstone Experience	Project

Outcomes of Curriculum Work

Outcomes

- specify the knowledge, skills, and capabilities that graduates of an MSwA program can expect when they complete the program
- represent the minimum capabilities that should be expected of professionals in the area of software assurance when they complete a master's degree program
- provide a model for curriculum content, organization, expected curriculum outcomes
- support those who assess software assurance programs

How Universities Can Adopt MSwA Material

MSwA Standalone Program (9 courses)

Assurance Management (2.1, 2.2, 2.3, 4.1, 4.2, 4.3)

Assurance Assessment (3.1, 3.2, 3.3, 6.4) *

System Operational Assurance (7.1, 7.2, 7.3)

System Security Assurance (5.1, 5.2, 5.3)

Assured Software Analytics (6.3)

Assured Software Development 1 (1.1, *1.2*, 6.1, 6.2 [requirements])

Assured Software Development 2 (6.1, 6.2 [specification, design])

Assured Software Development 3 (6.2 [code, test, verification, validation])

Software Assurance Capstone Experience

* This course is not present in the MSwA Courses Added to MSwE program.

The 1.2 knowledge unit, italicized, is different in Assured Development 1 in the standalone program and Assurance Management in the MSwA Courses Added to MSwE program.

MSwA Courses Added to MSwE Program (7 courses)

Assurance Management (*1.2*, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3)

System Operational Assurance (**3.1, 3.2, 3.3, 6.4,** 7.1, 7.2, 7.3)

System Security Assurance (5.1, 5.2, 5.3)

Assured Software Analytics (6.3)

Assured Software Development 1 (1.1, 6.1, 6.2 [requirements, specification, design])

Assured Software Development 2 (6.2 [code, test, verification, validation])

Software Assurance Capstone Experience

The bolded knowledge units are not covered at the same Bloom's level as in the standalone program.

Condensed versions of Assured Software Development 1, 2, and 3 from the standalone program are in the MSwE program.

Getting Started with MSwA Courses

Implementation options:

- add 1-2 courses that supplement an existing program (e.g., Master of Software Engineering, Master of Information Systems)
- build on strengths of faculty and supplement existing courses
- build on local industry needs
- take advantage of resources
  - mentoring offered by SwA curriculum team
  - other artifacts (e.g., MSwA course outlines, master bibliography)
- consider starting with a course that does not require prerequisites within the program, such as Assured Software Development 1 or System Operational Assurance
- add 1-2 courses each year to build up to a complete MSwA or specialization within another degree program

Interested Universities & Educators

Stevens Institute of Technology – offerings this Fall

Hampton University – plan under review

Team for Research in Ubiquitous Secure Technology (TRUST) – partners with Cal State universities

Gunter AFB – contact and follow up telecon

Southeast Missouri State U. – Bachelor's in cybersecurity

Other U.S. and international universities – Email exchange

Next Steps

SwA Project Curriculum Plans

2010 – 2011:

- outreach - identify transition opportunities for the curriculum (e.g., papers, seminars, workshops, faculty development)
- work with professional societies toward recognition of the curriculum (in progress)
- address community college needs

Detailed Transition Plans

The following efforts are associated with this project:

- publicity/awareness: press release, email announcements, podcast, flyer for conferences, VTE from CSEET 2010 (complete)
- publications: papers in *IEEE Computer*, *CrossTalk*, *International Journal of Secure Software Engineering (IJSSE)*, others planned
- discussion group: LinkedIn group (Available now)
- focused implementation group: universities actually implementing program (October)
- course resources: outlines and bibliography (complete), syllabi (February)

Additional SwA Curriculum Needs

MSwA course materials:

- complete materials for the 9 SwA core courses (slides, notes, exams, homework, case studies)

Curriculum development:

- MSwA course descriptions for specializations in other degree programs (e.g., Information Systems)
- Full undergraduate curriculum, with specializations in Software Engineering, Information Systems, Computer Science
- address high school needs

Resources

http://www.cert.org/mswa/

- MSwA Reference Curriculum document
- undergraduate course outlines
- MSwA course outlines
- master bibliography
- curriculum overview seminar
- VTE workshop from CSEET 2010

Contact Information

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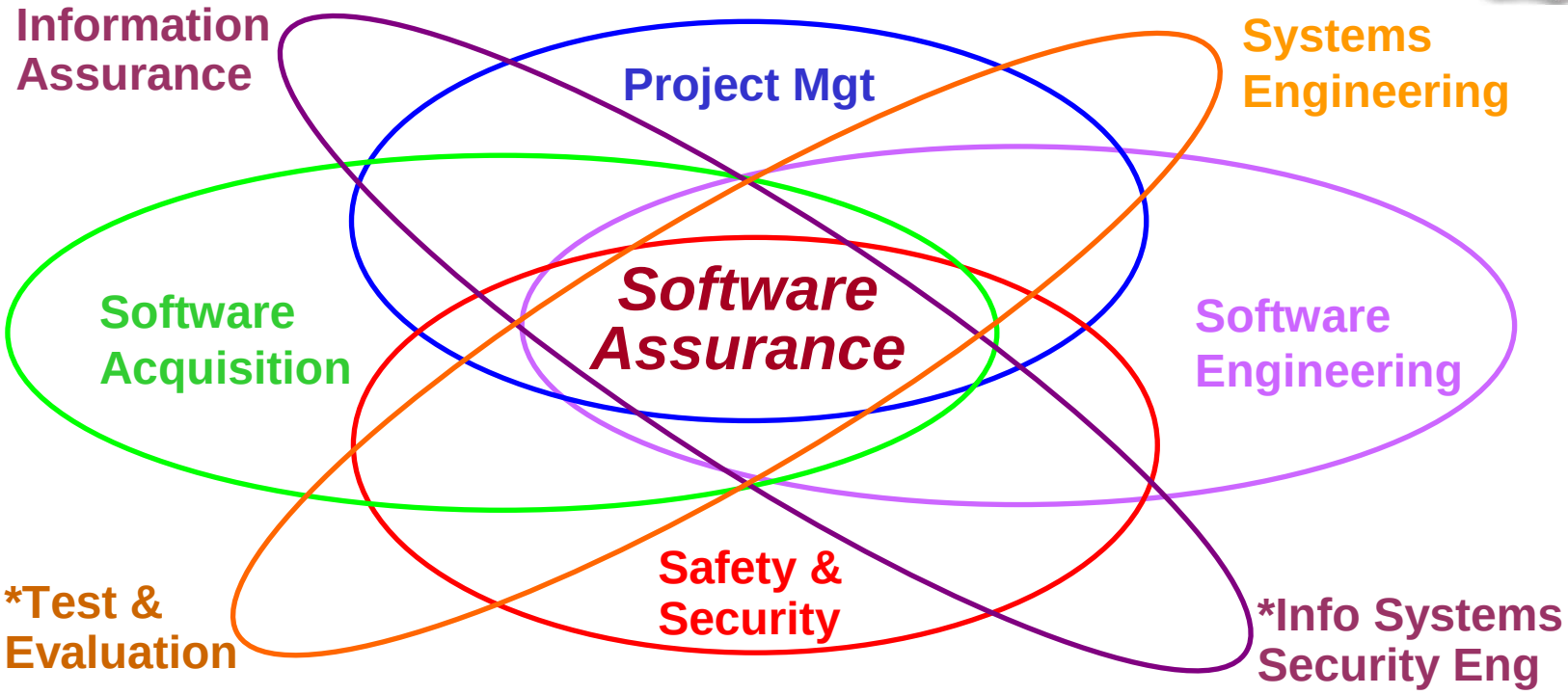
Backup

Background: Contributing Disciplines *



In Education and Training, Software Assurance could be addressed as:

- A “knowledge area” extension within each of the contributing disciplines;
- A stand-alone CBK drawing upon contributing disciplines;
- A set of functional roles, drawing upon a common body of knowledge; allowing more in-depth coverage dependent upon the specific roles.

Intent is to provide framework for curriculum development and evolution of contributing BOKs

Homeland Security

* See ‘Notes Page’ view for contributing BOK URLs and relevant links

The intent is not to create a new profession of Software Assurance; rather, to provide a common body of knowledge: (1) from which to provide input for developing curriculum in related fields of study and (2) for evolving the contributing disciplines to better address the needs of software security, safety, dependability, reliability and integrity.

Definition: Software Assurance [CNSS]

Committee on National Security Systems definition:

> Software assurance is the level of confidence that software is free from vulnerabilities, either intentionally designed into the software or accidentally inserted at any time during its life cycle, and that the software functions in the intended manner.

Started with this definition and modified it for the curriculum project

[CNSS 2009]

Definition: Software Assurance [MSwA]

Master of Software Assurance Curriculum Project definition:

> Application of technologies and processes to achieve a required level of confidence that software systems and services
>
> - function in the intended manner,
> - are free from accidental or intentional vulnerabilities,
> - provide security capabilities appropriate to the threat environment, and
> - recover from intrusions and failures.

[MSwA 2010]

Implied Differences: MSwA Curriculum

Areas of special emphasis and unique properties that distinguish the MSwA curriculum from traditional software engineering and computer science programs include a focus on

- software *and services*
- development *and acquisition*
- *security* and correct functionality
- *software analytics*
- *system operations*
- *auditable evidence*

Undergraduate Course Outlines

SwA Undergraduate Course Outlines Background

Corollary activity to MSwA curriculum development

Course outlines include description, prerequisites, syllabus (list of topics and Bloom's levels), course delivery features, suggestions on assessment, references

Background sources include SwACBK, MSwA Curriculum (Volume I)

Other sources include the following:

- CS2008 outlines
- Carnegie Mellon University outlines
- James Madison University outlines
- University of California, Davis outlines
- Purdue University outlines

SwA Undergraduate Courses

Computer Science I (with SwA emphasis)

Computer Science II (with SwA emphasis)

Introduction to Computer Security

Software Security Engineering

Secure Programming

Special Topics in Information Assurance and Security

Software Quality Assurance

Software Assurance Analytics

Software Assurance Capstone Project

SwA Undergraduate Specialization (5 courses)

Courses:

- Introduction to Computer Security
- Secure Programming
- Software Quality Assurance
- Software Assurance Analytics
- Software Assurance Capstone Project